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Peer Review Report

Peer review report 1 On "Hydrological response to dynamical downscaling of climate model outputs: a case study for western and eastern snowmelt-dominated Canada catchments"

Original Submission

Recommendation:

Revision

Comments to Author:

Manuscript Number: EJRH-D-15-00108

Title: Hydrological response to dynamical downscaling of climate model outputs: a case study for western and eastern snowmelt-dominated Canada catchments.

Summary: This study examines hydrologic responses from the SWAT hydrological model driven by multiple GCMs and RCMs for the 1971-2000 study period. The study focused on evaluating hydro-climatic variables consisting of air temperature, precipitation, evapotranspiration, SWE and runoff. The manuscript is relatively well developed but tedious to follow in some places. I also read the published paper by the authors (Troin et al., 2015) and found that this manuscript shares much of the data, methods and some of the results with the already published work. Given that most of the findings of this study are already known from the author's own work or similar studies elsewhere, I am struggling find meaningful contribution of this study. I also find this paper unnecessarily long: i.e., too much discussion on already known information and concepts, and multiple figures basically providing same information; but lacking in new insights or novelty. Given below are my major and specific comments:

Major comments:

1. Bias correction of GCMs/RCMs is a standard practice in the hydrologic impacts of climate change studies. In fact the authors themselves applied two bias correction methods in their earlier paper (Troin et al., 2015). So I find it strange that the authors chose to compare bias corrected and biased results in this manuscript. Results such as ".. both CRCM and GCMs were biased in the simulation of climate variables, resulting in biased simulated catchment water components" are hardly new or surprising. In fact biased results such as cold bias in temperature make the hydrologic simulation completely unrealistic and of little use for hydro-climatic assessment.
2. The authors also compared SWAT model simulations driven by the bias corrected GCMs and RCMs and tried to find the added value of using RCMs. Although the authors tried very hard to find added value, the hydrologic simulations showed very little differences. This is hardly surprising because bias correction makes the statistical characteristics of precipitation and temperature equivalent to observations, regardless of whether GCMs or RCMs are used. So unless the authors can come up with a bias correction method which preserves the variability of higher resolution RCMs, it will be hard to distinguish differences in the hydrologic responses. So results such as, ". . .when looking at the bias correction results, the benefit of using the RCM versus GCMs no longer emerged distinctly, since both provided consistent reproductions of catchment water components" do not add any new insight.

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2214-5818/$ – see front matter
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3. I also find it surprising that authors chose to present CMIP3 GCMs and RCMs results for this study. CMIP5 GCMs and RCMs have been available for some time now, and CRCM5 is of higher resolution (~15 km). The results of this study hinted that RCMs may have added value in the mountainous region of BC. Although the results are not conclusive because it based on one-catchment, using a higher resolution RCM will perhaps enable the authors to explore the "added value" more effectively in the mountainous regions.
4. In this study, the authors chose to present uncertainty due to internal variability of GCMs/RCM. I agree that this uncertainty is important, but a number of studies have shown that uncertainties due to GCMs and emission scenarios (or RCPs) are much larger than those due to internal variability, so I believe that the authors also need to consider these uncertainties.

Specific comments.

L76-119: This introduction is unnecessarily long, most of that is well known so could be shortened considerably.

L120-122, L185-L187: It is not clear what the main objective of this study is. Is it "evaluation of the RCM as a tool to improve GCM simulations for hydrological applications"? Or the "assessment of how the uncertainties affect the hydrological response of the study catchments when focusing on annual extreme floods (extreme spring events), summer high flows and winter low flows" ?

L169-180. It appears that the authors chose to focus on uncertainty due to internal variability mainly due to availability of the simulations from previous studies, but they did not mention that this may not be the largest source of uncertainty.

L213-253: The discussion on GCMs and RCMs used could be summarized in a table.

L278-298: SWAT is a well-known model is the hydrologic modelling community. So instead of providing a general description, it will be more relevant to talk about why this model is used for the snow-dominated catchments.

L302-303: Nechako is a regulated river system and the data from WSC hydrometric station is regulated. So it is not clear how the reservoir regulation is handled in this study. Please clarify.

L317: How many parameters were used for calibration?

L333-335: Not so sure that the three levels of headings are necessary.

L364-379: The match between observed and bias corrected precipitation is by design, so this paragraph describing the match is not necessary, neither is it necessary to show the match in Figures 3 and 4 (both of which provide the same information).

L382-433: It is a known fact both GCMs and RCMs have biases, and RCMs can either increase or decrease the GCM bias, so I see little value of this discussion and Figures 4 and 5.

L435-481: The authors tried very hard to find differences due to the internal variability. But in reality, the differences are hard to distinguish, mainly because the bias correction makes the statistical characteristics of these variables equivalent.

L488-544: Biased inputs give biases outputs, isn't this obvious?

L574-670: while I appreciate the need to evaluate seasonal high/flow flows and annual extremes, the differences tend to disappear due to the effect of bias correction. This again makes me think that a better bias correction approach and/or higher resolution RCM is needed for such an evaluation.

Troin, M., Velázquez, J.A., Caya, D., Brissette, F. 2015. Comparing statistical post processing of regional and global climate scenarios for hydrological impacts assessment: A case study of two Canadian catchments. Journal of hydrology 520, 268-288.

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